atives of the respective Committees, and to qualify himself as far as possible for the honourable post of local correspondent. It is in return for the prospect of this very valuable assistance that the position of a member of the General Committee is granted to each delegate, and the privilege is accorded of having published in the *Reports* of the British Association a catalogue of the local investigations of the Society which he represents. Hereafter the Corresponding Societies Committee will take into consideration the advisability of not recommending for re-election those Societies whose delegates fail to attend the meetings of the Conference without adequate explanation.

These views were expressed by the Chairman at the second meeting of the Conference, and they appeared to be fully in harmony with the feelings of the delegates who were present.

The above extracts contain all that is of general importance in the circular letter. Whether or no the Conference of Delegates will grow into an important branch of the British Association remains to be seen. The rules under which it is established ought to secure it from the danger of provoking the jealousy of Local Societies by the assumption of a dictatorial attitude towards them and by interfering in their concerns; on the other hand they as surely prevent it from growing into the anomalous office of an *imperium in imperio* as regards the British Association. Consequently the success of the Conference appears wholly to depend on an abundant and continuous supply of good work being found for it to do, and on a sufficiency of zeal among the delegates to perform their duties efficiently.

FRANCIS GALTON

DR. CARPENTER, C.B., F.R.S.

A SHORT sketch of the life and work of the eminent naturalist who has recently passed from among us will be welcome to the readers of NATURE.

William Benjamin Carpenter was born at Exeter in 1813, and was the fourth child and eldest son of Dr. Lant Carpenter, a Unitarian minister. His sister, Mary Carpenter, who died a few years since, achieved the most important work as a philanthropist, in relation to the treatment of prisoners and to questions affecting our Indian fellow-subjects, and will be remembered by future generations with no less gratitude than her brother.

In his childhood Dr. Carpenter received an excellent education, comprising both classics and the principles of physical science, at the school established by his father at Bristol, and it was his intention to adopt the profession of a civil engineer. He was, however, persuaded to accept the opportunity offered by a medical practitioner, Mr. Estlin, of Bristol, and to enter on the study of medicine as apprentice to that gentleman. Shortly after this he was sent, as companion to one of Mr. Estlin's patients, to the West Indies, and on his return from this visit he entered, at the age of twenty, the medical classes of University College, London. After passing the examinations of the College of Surgeons and the Apothecaries' Society he proceeded to Edinburgh, where he graduated as M.D. in 1839.

His graduation thesis on "The Physiological Inferences to be deduced from the Structure of the Nervous System of Invertebrated Animals" excited considerable attention, especially on account of the views which he advanced as to the reflex function of the ganglia of the ventral cord of Arthropoda.

From the first Dr. Carpenter's work showed the tendency of his mind to seek for large generalisations and the development of philosophical principles. He was a natural philosopher in the widest sense of the term—one who was equally familiar with the fundamental doctrines of physics and with the phenomena of the concrete sciences of astronomy, geology, and biology. It was his aim, by the use of the widest range of knowledge of the facts of Nature, to arrive at a general conception of these phenomena as the outcome of uniform and all-pervading laws. His interest in the study of living things was not therefore primarily that of the artist and poet so much as that of the philosopher, and it is remarkable that this interest should have carried him, as it did, into minute and elaborate investigations of form and structure. Although some of his scientific memoirs are among the most beautifully illustrated works which have been published by any naturalist, yet it is noteworthy that he himself was not a draughtsman, but invariably employed highly skilled artists to prepare his illustrations for him. Yet we cannot doubt that the man who, with his dominant mental tendency to far-reaching speculations, yet gave to the world the minute and ingenious analysis of the beautiful structure of the shells of Foraminifera, had an artist's love of form, and that the part of his life's work (for it was only a part among the abundant results of his extraordinary energy) which was devoted to the sea and the investigation of some of its fascinating living contents, was thus directed by a true love of Nature in which ulterior philosophy had no share.

Two books, Dr. Carpenter has told us, exerted great influence over his mind in his student days: they were Sir John Herschel's "Discourse on the Study of Natural Philosophy" and Lyell's "Principles of Geology"—that great book to which we owe the even greater books of Charles Darwin. Taking the "Principles" in some way as his model, Dr. Carpenter produced in 1839 his first systematic work, under the title "Principles of General and Comparative Physiology, intended as an Introduction to the Study of Human Physiology and as a Guide to the Philosophical Pursuit of Natural History." Admirable as was the execution of this work in many ways, its great merit lay in the conception of its scope. It was in fact the first attempt to recognise and lay down the lines of a science of "Biology" in an educational form. Carpenter's "Comparative Physiology" is the general or elementary "Biology" of the present day—traced necessarily upon the less secure foundations which the era of its production permitted, viz. one year only subsequent to the date of Schwann's immortal "Microscopical Researches."

For five years Dr. Carpenter remained in Bristol, commencing medical practice and marrying in 1840; but in 1844, feeling a distaste for the profession of medicine, he removed to London in order to devote himself entirely to a literary and scientific career. He was encouraged to take this step by the success which his "Comparative Physiology" obtained, a second edition having been called for within two years of the publication of the first. He was appointed Fullerian Professor of Physiology in the Royal Institution during his first year in London, and Professor and Lecturer at University College and at the London Hospital, whilst he was also elected a Fellow of the Royal Society.

In 1851 Dr. Carpenter became Principal of University Hall, the residential institution attached to University College, where he remained until 1859. During this period he remodelled his treatise on Physiology, issuing the more general biological portion as "Comparative Physiology," whilst that portion dealing with the special physiology of man and the higher animals appeared as his well-known "Human Physiology," which subsequently ran through many editions. The "Human Physiology" is remarkable in the first place for the chapters on the physiology of the nervous system, and especially for the theories enunciated with regard to the relations of mind and brain, and the attempt to assign particular activities to particular portions of the cerebral structure. In arriving at his conclusions Dr. Carpenter had to depend on arguments drawn from the facts of comparative anatomy and of diseased or abnormal conditions in man. There is no doubt at the present day of the acuteness which he displayed in his treatment of the subject, and of the truth in a general way of the results which he formulated. Experiment and a wider range of observation have to some extent corrected—but on the whole rather extended and confirmed—the doctrines of the early editions of the "Human Physiology" in regard to this subject, so that he was able only a few years since to separate this portion of the work and issue it as a separate book, the "Mental Physiology," in which is contained by far the most complete, consistent, and readable account of the phenomena of mind, and their relation to the actual structure of the brain, which exists. Such topics as Instinct, Mesmerism, Somnambulism, Unconscious Cerebration (his own phrase), &c., are discussed in a masterly way, and with an abundance of illustration and knowledge which renders the work one of the greatest value even to those who may differ there and there from its theoretical conclusions.

About the period of his removal to London Dr. Carpenter began to occupy himself with the minute study of the structure of the calcareous shells of the Mollusca—being led thereto by a desire to compare the results of the operation of living matter upon distinctly mineral compounds (such as carbonate of lime), by way of comparison and in illustration of the rapidly accumulating knowledge of cell-structure in the softer parts of living things. This study, which resulted directly in some valuable contributions to our knowledge of the structure of shells, shown by these researches to be far more complex than had hitherto been supposed, led on the one hand to Dr. Carpenter's permanent identification with the pursuit of research with the microscope, and on the other hand to those admirable investigations of the structure and law of growth of the shells of the minute Protozoic Foraminifera which constitute his most weighty contribution to the special literature of science. His microscopic studies bore fruit in the publication of "The Microscope and its Revelations," the sixth edition of which was issued in 1881. The studies on the shells of Foraminifera were continued throughout his life, being published in four memoirs in the *Philosophical Transactions*, and in a richly illustrated monograph produced by the Ray Society in 1862, whilst the last of his memoirs in the *Philosophical Transactions* was that on Orbitolites bearing date so late as 1882. It was on this subject that Dr. Carpenter was busy at the time of his death, having during the past few years accumulated a wealth of material and drawings in support of his contention that the *Eozoon canadense* discovered by Logan in the Laurentian rocks of Canada exhibits the distinctive structure of the shell-substance of the higher Foraminifera. There is reason to hope that the memoir which he had nearly completed on this subject may yet be brought by his son, Dr. Herbert Carpenter, into a finished form and published.

At the age of forty (1853), what with his larger and smaller books, his original researches, his lectures on medical jurisprudence at University College, and numerous popular lectures on scientific topics, Dr. Carpenter's life was unusually laborious and productive.

In 1856 he was appointed Registrar of the University of London, and for twenty-three years administered the onerous duties of that office in such a way as to contribute in no small degree to the success of the University, and above all to the maintenance of the high character of its degrees and the ample recognition of the study of natural science for which the University is now distinguished.

He was able now to give a larger amount of time than formerly to his original investigations, and, in his summer holidays at Arran and elsewhere, commenced, amongst other studies, those researches on the structure and development of the beautiful little feather-star, which were from time to time published in the *Philosophical Transactions*, and led to his association with Wyville Thomson, and thus to the deep-sea explorations of the *Lightning*, and subsequently of the *Challenger*.

Carpenter's memoirs on Comatula give a very full and beautifully illustrated account of the structure of the skeleton of the feather-star, but for many years the view which he entertained with regard to the nature of the axial cord which runs through the segments of the arm-skeleton of that animal was regarded by all other observers (with scarcely an exception) as erroneous. Dr. Carpenter considered these cords as nerve-cords, and after his retirement from official life he made a special visit (only five years or so ago) to the marine laboratory erected by Dr. Dohrn at Naples, in order to test his views by the repetition, on an extensive scale, of experiments which had already appeared convincing to his mind. These experiments, and others since carried out by younger naturalists, have at length fairly established the view for the truth of which the veteran observer had long contended.

The deep-sea explorations which Dr. Carpenter, assisted by Prof. Wyville Thomson, arranged, and for which he succeeded in obtaining the aid of ships of the Royal Navy, were designed not merely to search for organisms in the great depths of the ocean, but especially to study the ocean currents both deep and superficial, Dr. Carpenter having a strong desire to enter upon the explanation of the great physical phenomena presented by the ocean. He himself took part in the earlier expeditions in 1868 and subsequent years, and though unable to leave the ties which bound him to home, so as to join the long *Challenger* Expedition, yet he closely watched the results then obtained, and embodied the whole of his observations, and those reported from the *Challenger*, in some extremely suggestive and important memoirs and lectures on ocean circulation.

In 1879 he retired from the Registrarship of the University of London with a well-earned pension, and was at once chosen as a member of the Senate of that body. He now devoted himself with unabated vigour to the prosecution of his studies on Foraminifera and on Comatula, and to more theoretical matters, such as ocean-currents, and the explanation of the frauds of spirit-mediums. Though released from the duties of office, he was still a constant attendant at the Senate of the University, he rarely missed a meeting of the Royal Society or one of the annual gatherings of the British Association, and, besides undertaking the administration of the Gilchrist trust, delivered many lectures in all parts of the country himself—both independently and as an emissary of the trustees. The scheme of lectures and scholarships instituted by the Gilchrist trustees, which is effecting an important educational work in natural science among classes of society excluded from regular University teaching, is Dr. Carpenter's work. He wrote at this time in the interest of the public health some admirable articles on vaccination, as in earlier life (1849) he had from a similar point of view treated the subject of alcoholic liquors, and had urged the arguments for total abstinence. When past seventy years of age he did not shrink from a journey to the United States, where he spoke and lectured with unflagging vigour. The last public movement in which he took an active part was the foundation of the Marine Biological Association, of which he was a Vice-President, and which is about to carry out, by means of its laboratory on Plymouth Sound, a suggestion which is traceable to his own proposition for the thorough exploration and study of Milford Haven.

The abundant and noble achievements of Dr. Carpenter's public and scientific career did not pass without recognition in the form of awards and titles. He received in 1861 one of the Royal medals awarded by the Council of the Royal Society, and in 1883 the Lyell medal of the Geological Society. In 1871 he was made an honorary LL.D. of the University of Edinburgh, and in 1872 he was President of the British Association for the Advancement of Science, when it met at Brighton. In 1873 he was elected Corresponding Member of the Institute of France, and on his retirement from his official position at the University of London in 1879 he was nominated C.B.

It is impossible to do justice to Dr. Carpenter's character as a scientific man in a few lines: here no attempt has been made to do more than indicate in something like chronological order and connection of subjects the vast amount of work which he accomplished.

Upon the present writer, whose father was his fellow-student at University College, and who has enjoyed since boyhood the privilege of his friendship, Dr. Carpenter always produced the most vivid impression of a man of indomitable energy, who had accepted as the highest duty and keenest delight of his life, the promotion, whether by advocacy or by research, of true knowledge. The tenacity and vigour with which he was wont to expound his views on such matters of research as at the time occupied his thoughts, and the importance and respect which he assigned to all genuine research, were evidences of an earnest and just nature which evoked sympathy and esteem in all men of kindred pursuits.

In reference to Dr. Carpenter's private life and tastes, the following extract from a weekly contemporary states, with the authority of a member of his own family, what might, in its absence, have been here less completely indicated. The journal to which we are thus indebted is an organ of the Unitarian Church, of which body Dr. Carpenter was, throughout life, an active and orthodox member, a fact which may or may not be brought into connection with the fact of his incomplete acceptance of the leading doctrines of Darwinism, though the latter would by no means necessarily follow from the former.

"He was well versed in literature, and turned for refreshment in hours of weariness to his favourite Scott. Political memoirs of his own time were read with the keenest relish, for he had early learned from his father, Dr. Lant Carpenter, to take a high view of a citizen's obligations, and the Bristol riots, which he had witnessed, made a life-long impression upon him. A brief sojourn in Italy called forth a susceptibility to the enjoyment of art, which was a surprise even to himself; and in music, from the time that he had taught himself as a young man to play on the organ, he found unfailing recreation. Nature, likewise, in her vaster as well as her microscopic forms, was for him full of charm and delight, and from every excursion he carried back memories which remained singularly vivid and distinct. In society his immense stores of information, his sympathetic interest in others, his thorough enjoyment of humour though he felt unable to originate it, made him a genial and ever-welcome companion, while his friends learned how strong a confidence might be placed in his faithfulness. Many young men found unexpected help and encouragement in him, and he rejoiced when he could open a way to those who were involved in the struggles through which he had himself once passed. The dominant conception of his life—as was fitting in one of Puritan descent—was that of duty. And if this sometimes took austere forms, and led him to frame expectations which others could not always satisfy, an enlarging experience mellowed his judgment and enabled him to apprehend their position from their point as well as his own. Released from the pressure and strain of earlier life, he was able to give freer play to his rich affections; and in his own family they only know what they have lost who will never again on earth feel his support as husband and father, brother, and friend."

E. RAY LANKESTER

WALTER FLIGHT, D.Sc., F.R.S.

THE close of this year has witnessed the termination of another bright and promising life, ended all too soon for the hopes and expectations of his many friends.

Walter Flight was the son of William P. Flight, of Winchester, in which city he was born on January 21, 1841. He was sent, after a period of pupilage at home, to Queenwood College, Hampshire, in the days when George Edmondson was head master, and Tyndall and Debus were the teachers of science. From Queenwood he went to the University of Halle, where, in the laboratory of Prof. Heintz, he pursued his chemical studies during the winter session of 1863-64. During 1864 and 1865 he entered the University of Heidelberg, where, in the laboratories of the celebrated Profs. Bunsen, Kopp, and Kirchhoff, he applied himself early to acquire that thorough knowledge of the various branches of theoretical and practical chemistry, and that marked facility for overcoming experimental difficulties which characterise the practised and careful worker. From Heidelberg Flight passed to the University of Berlin, where he remained until 1867, studying and working in Prof. Hofmann's laboratory, and for a time filling the office of his Secretary and Chemical Assistant.

Returning to England in 1867, he graduated D.Sc. in the University of London, and in the following year was appointed by the Senate to the office of Assistant Examiner under Prof. Debus (his former teacher at Queenwood). On September 5, 1867, Dr. Flight was appointed an Assistant in the Mineralogical Department of the British Museum. Here, under the direction of Prof. Maskelyne, the Keeper of Mineralogy, he commenced a series of researches into the chemical composition of the mineral constituents of meteorites and the occluded gases they contain. Many of the methods by which he carried out these investigations were originated by him in the course of the research, and displayed in a remarkable degree his skill and ingenuity in chemical manipulation.

He was shortly after this date appointed Examiner in Chemistry and Physics at the Royal Military Academy, Woolwich, and in 1876 Examiner to the Royal Military Academy, Cheltenham.

For several years Dr. Flight served on the Luminous Meteors Committee of the British Association, to which he lent much valuable assistance.

Between the years 1864 and 1883 he was author of twenty-one original papers, including "A Chapter in the History of Meteorites," which appeared in a succession of twenty-three articles in the *Geological Magazine* in 1875, 1882, and 1883. He was also joint author or contributor of results to many other papers, chiefly on the chemical composition of minerals. His important memoir on the Cranbourne, Rowton, and Middlesbrough meteorites was read before the Royal Society in 1882, and he was elected a Fellow in the following year.

In 1884 he was seized by illness which prostrated his mental powers, and rendered it needful for him to resign his appointment in the British Museum in June last, and notwithstanding every care which medical skill or affection of friends could devise, he succumbed on November 4, leaving a wife and three young children to deplore his early loss.

ON RADIATION OF HEAT FROM THE SAME SURFACE AT DIFFERENT TEMPERATURES

FOR some time past I have been engaged in experimenting on the radiation of heat from the surfaces of wires in air and in vacuum, and I have obtained results which have been partially communicated in papers to the Royal Society (1884) and to the British Association at its last two meetings. I am at present preparing to publish further determinations of emissivities in absolute measure. In the meantime, however, I have obtained a result of some importance which may be of interest to the readers of NATURE.

Stefan has given a law, which is well known, as to the